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(54) MELANGE DE GRAISSES CONTENANT DES PHOSPHOLIPIDES AVEC DES ACIDES GRAS POLYINSATURES A LONGUE CHAINE

(54) MIXTURE OF PHOSPHOLIPID-CONTAINING FATS AND LCP FATTY ACIDS

(57)

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(57) Abrégé/Abstract:
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Abstract

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Phospholipid-containing Fat Mixture Containing LCP Fatty Acids

DESCRIPTION

The invention concerns a formula food containing a fat mixture based on animal and plant, including microbial, oils and/or fats and lecithins containing long-chain polyunsaturated fatty acids and also such a fat mixture for the preparation of a formula food.

Long-chain polyunsaturated fatty acids with in particular 20 to 22 carbon atoms, so-called LCP fatty acids, are synthesised in the human body by chain extension and desaturation from the essential fatty acids linolic and linolenic acids. Hence, linolic acid (18-2w6) and α-linolenic acid (18-3w3), which are respectively a w6 and a w3 desaturated fatty acid, must be absorbed with the food, linolic acid being the starting compound for the w6-LCP fatty acid group, and α-linolenic acid the starting compound for the w3-LCP group.

However in the rapidly growing body of the baby, the endogenous synthesis of LCP fatty acids is still very limited. To supply only the precursor fatty acids linolic acids and α-linolenic acid is not sufficient. On the basis of studies, it could be shown that babies who are not supplied with LCP fatty acids in their food display significant differences compared to breast-fed babies, both in the biochemical parameters of the blood, and also in functional properties, such as visual acuity and psychomotor tests.

LCP fatty acids, of which arachidonic acid (AA: 20-4w6) and docosahexaenoic acid (DHA: 22-6w3) are the most important, are accumulated to a considerable extent in the brain, especially in the last third of the pregnancy and the first months of life after birth. Before birth, the LCP fatty acids are made available to the foetus via the placenta. After birth, the baby receives these fatty acids with the maternal milk, since human milk contains both w6 and

also w3-LCP, of which arachidonic acid and docosahexaenoic acid are the most important components by quantity.

Now, formula foods or baby-foods which contain such LCP fatty acids are already known; concerning this, see EP-A 0 404 058, EP-A 0 231 904 and US-A 4 670 285. In these known milk baby-foods or the fat mixtures contained therein, the contents of the LCP fatty acids are more or less approximated to the values of the total lipids of human milk. In these known formula foods or the fat mixtures contained therein, account is taken of the quantity of the supplemented LCP fatty acids, but not of the form in which these fatty acids are bound.

The total lipids of human milk consist of about 97 to 99 % triacylglycerides and about 0.5 to 2 % phospholipids. In addition, free fatty acids, mono- and diacylglycerides, glycolipids and cholesterol and phytosterol also occur in human milk. The LCP fatty acids in human milk are about 90 to 95 % present in the form of triglycerides and about 5 to 10 % in the form of phospholipids.

In contrast to this, in EP-A-O 484 266, the incorrect view is held that the main proportion of the long-chain polyunsaturated fatty acids (LCP fatty acids) in human milk are present in the form of phospholipids. Consequently, the addition of LCP fatty acids to dietetic foods in the form of phospholipids from the brain fat of mammals is recommended there. Through the use of such fatty acid phospholipid compositions and through the additional use of fish oil, the LCP contents in these known foods are also approximated to the ratios of the total lipids in human milk.

Moreover, because of the composition of the animal and/or plant starting materials it is not possible to constitute baby-foods or a fat mixture on the basis of animal and plant fats and oils in such a way that this "artificial" food more or less exactly corresponds to human milk. Rather it is necessary to choose and decide which of the many components matter, and which components are added in what proportions to an "artificial" food.

If now one attempts to imitate the fat mixture in human milk on the basis of animal, plant and microbial oils, fats and lecithins more or less with regard to the LCP fatty acids, then this is only possible with costly raw materials, which are moreover not even available yet in sufficient amount.

The purpose of the present invention is to provide an improved formula food and an improved fat mixture for the preparation of this formula food, which as closely as possible approximates to the nutrient quality of human milk.

This purpose is fulfilled by the teaching of claim 1 and claim 6.

The formula foods or fat mixtures representing the state of the technology are adjusted to the ratios of the total lipids in human milk as regards their content (absolute) of the LCP fatty acids in question here. Surprisingly, it has now been found that the total LCP fatty acids content of the formula feeds can be reduced, if part of the arachidonic acid and docosahexaenoic acid are available in the form of phospholipids in the proportion according to the invention.

Thus the addition of LCP fatty acids in the form of triglycerides, such as is the case in the known formula foods, can be considerably decreased, and the costs of the LCP fatty acids supplementation thereby reduced.

Thus it has surprisingly been found that it matters that a certain proportion of the total arachidonic acid and docosahexaenoic acid present are made available to the neonate in the physiologically important form of the phospholipids. On the basis of clinical studies, it could be shown that babies which are fed with a formula food which contains the arachidonic acid present in the form of phospholipids in a proportion of 0.3 to 3.0 mg/g total fat and the docosahexaenoic acid present in the form of phospholipids in a proportion of 0.1 to 2.0 mg/g total fat, the proportion of arachidonic acid and docosahexaenoic acid present in the form of triglycerides having been reduced compared to the conventional foods, display functional properties (visual acuity, motor properties) and biochemical blood parameters which very

closely approximate to those of breast-fed babies. Thus it is physiologically decisive that the docosahexaenoic acid and the arachidonic acid are added to a formula food both in triglyceride form and also in phospholipid form in the proportions claimed according to the invention.

According to a preferred embodiment, the weight ratio of the arachidonic acid present in the form of triglycerides to docosahexaenoic acid present in the form of triglycerides is 0.5:1 to 20:1.

At the same time, the weight ratio of arachidonic acid present in the form of phospholipids to docosahexaenoic acid present in the form of phospholipids is preferably 0.5:1 to 1:5.

Moreover, the arachidonic acid and the docosahexaenoic acid are preferably present as phosphoglycerolipids, and furthermore preferably in the form of phosphatidylcholine and phosphatidylethanolamine.

A further subject matter of the invention is a fat mixture which contains the LCP fatty acids in the stated form and in the stated proportions. This fat mixture is suitable for the preparation of a baby- and premature baby-food, especially milk baby-food. Moreover, the term formula food is taken to mean any formula food which is "artificial" and hence prepared without use of human milk and without use of the components of human milk.

The formula food according to the invention and of course also the fat mixture according to the invention can be prepared by mixing triacylglyceride-containing animal and plant oils and fats with animal, plant and/or microbial phospholipids (lecithins) which contain LCP fatty acids. As animal fats, for example butter fat, organ fats such as kidney, liver and brain fat, and also fish oils, can be used. As plant oils, oils from mono- and dicotyledonous plants (palm oil, soya oil, sunflower oil, etc.) can be used. Furthermore, oils of microbial origin (SCO) such as algal or fungal oils can be used. The LCP fatty acids arachidonic acid and docosahexaenoic acid used in the form of phospholipids are introduced into the fat mixture or formula food according

to the invention in the form of phospholipids of animal, plant and microbial origin. Among these phospholipids are lecithins from fish, from other marine organisms such as mammals, krill, cephalopods, etc., from egg lipids, from animal brain and other organ lipids and from macro- and microalgae and/or from microorganisms.

If it is assumed that a finished formula food (e.g. milk baby-food) has a fat content of 4 % or 4 g/100 ml, then in a formula food according to the invention the arachidonic acid present in the form of phospholipids makes up 0.6 to 15 mg and the docosahexaenoic acid present in the form of phospholipids makes up 0.3 to 10 mg, per 100 ml formula food.

A further subject matter of the invention is a process for the preparation of a fat mixture according to the invention. In this, animal, plant and/or microbial oils and/or fats, which contain no LCP fatty acids or only small proportions of LCP fatty acids (this relates in particular to fats and oils which were already previously used for the preparation of formula foods not supplemented with LCP fatty acids), are mixed with a source of arachidonic acid and docosahexaenoic acid that are present in the form of phospholipids or with animal and plant, including microbial, oils, fats and/or lecithins, which contain arachidonic acid and docosahexaenoic acid in the form of phospholipids, in a known way, such that these arachidonic acid and docosahexaenoic acid fulfil the values specified in claims 1 to 4. Here the mixing of the various oils, fats and/or lecithins can take place according to the state of the technology; concerning this, see for example EP-A 0 231 904 and EP-A 0 404 058. A formula food can then be prepared from this fat mixture, likewise according to the state of the technology.

The composition of five fat mixtures according to the invention and the fatty acid patterns resulting therefrom are set out in table 1 below. These fat mixtures are prepared by mixing the fat raw materials set out in this table 1. Table 2 shows the composition of various formula foods according to the invention, which were prepared using the fat mixtures illustrated in table 1. For the preparation of the formula foods set out in table 2, the components

quoted there are mixed together. By the addition of drinking water, ready-to-drink formula foods can be prepared from these. For this, 13 g of the composition or formula food described in table 2 is added to 90 ml drinking water and mixed. 100 ml of the ready-to-drink formula foods thus obtained have the absolute contents set out in the following table 3 of the fatty acids mentioned there.

The abbreviation or nomenclature for the fatty acids used in the present documents is explained in more detail inter alia in "Lipid Analysis", by William W Christie, Pergamon Press, 1973.

TABLE 1

Composition of several fat mixtures according to the invention and the fatty acid patterns resulting therefrom (quantities given in weight %)

	Ex.1	Ex.2	Ex.3	Ex.4	Ex.5
Fat raw materials:					
butterfat	30	30	30	30	30
sunflower oil (Hyp.)	10	10	10	10	10
palm oil	25	24	21.5	21.5	21.5
coconut/palm nut oil	14	13	12	10	7
rapeseed oil	5	5	5	5	5
soya oil	14	13.5	13.5	11.5	9.5
lecithin[1]	2	4	8	12	17
Fatty acids:					
4-0	0.77	0.77	0.77	0.77	0.77
6-0	0.59	0.59	0.59	0.59	0.59
8-0	1.25	1.18	1.12	1.00	0.81
10-0	1.66	1.60	1.55	1.44	1.27
12-0	8.56	8.03	7.49	6.45	4.88
14-0	6.31	6.14	5.94	5.60	5.10
16-0	22.73	22.86	22.52	23.08	23.78
16-1	0.71	0.75	0.82	0.91	1.01
18-0	5.13	5.21	5.37	5.54	5.76
18-1w9/w7	33.81	34.27	34.65	35.78	37.26
18-2w6	13.86	13.85	14.17	13.72	13.44
18-3w6	0.08	0.08	0.09	0.08	0.07
18-3w3	1.73	1.73	1.80	1.75	1.73
20-3w6	0.02	0.03	0.03	0.04	0.05
20-4w6	0.07	0.10	0.17	0.24	0.33
20-5w3					
22-6w3	0.04	0.07	0.13	0.20	0.28

[1] = the values relate to a lecithin fraction based on egg lipids with a phospholipid content of 30 wt % of the total fat.

TABLE 2
Composition of various formula foods according to the invention
(values given in g)

Fat mixture according to one of examples 1-5	27.7 g
Whey proteins	7.4 g
Casein	6.6 g
Lactose	55.1 g
Minerals and trace elements	3.0 g
Vitamin mixture	0.2 g
	100.0 g

For the preparation of a ready-to-drink formulation, 13 g of the composition described above are mixed with 90 ml drinking water.

TABLE 3

Absolute content of arachidonic and docosahexaenoic acids in baby-foods

Fatty acid: absolute content from phospholipids

Values given in: mg/100 ml

	Ex.1	Ex.2	Ex.3	Ex.4	Ex.5
Arachidonic acid (AA)	1.1	2.1	4.2	6.4	9.0
Docosahexaenoic acid (DHA)	0.8	1.7	3.3	5.0	7.0

Fatty acid: absolute content from triglycerides

Values given in: mg/100 ml

	Ex.1	Ex.2	Ex.3	Ex.4	Ex.5
Arachidonic acid (AA)	0.7	0.8	1.0	1.3	1.5
Docosahexaenoic acid (DHA)	0.05	0.1	0.2	0.3	0.5

PATENT CLAIMS

1. A fat mixture based on animal and plant, including optionally microbial, oils and/or fats and lecithins containing long-chain polyunsaturated fatty acids, characterised in that the arachidonic acid present in the fat mixture in the form of phospholipids makes up 0.2 to 3.0 mg/g total fat and the docosahexaenoic acid present in the form of phospholipids makes up 0.1 to 2.0 mg/g total fat, and that the arachidonic acid and docosahexaenoic acid present in the fat mixture in the form of triglycerides each make up 0.05 to 1.5 wt %, based on the sum of the fatty acids present in the form of triglycerides.

2. A fat mixture according to claim 1, characterised in that the weight ratio of the arachidonic acid present in the form of triglycerides to the docosahexaenoic acid present in the form of triglycerides is 0.5:1 to 20:1.

3. A fat mixture according to claim 1 or 2, characterised in that the weight ratio of the arachidonic acid present in the form of phospholipids to the docosahexaenoic acid present in the form of phospholipids is 0.5:1 to 5:1.

4. A fat mixture according to any one of claims 1 to 3, characterised in that the arachidonic acid from phospholipids makes up 0.5 to 1.5 mg/g total fat and the docosahexaenoic acid from phospholipids makes up 0.2 to 1.0 mg/g total fat.

5. A fat mixture according to any one of claims 1 to 4, characterised in that the arachidonic acid and docosahexaenoic acid are at least partly present in the form of phosphatidylcholine and phosphatidylethanol-amine.

6. Formula foods prepared with a fat mixture according to any one of claims 1 to 5.

7. Process for the preparation of a fat mixture described in one of the claims 1 to 5, characterised in that a first component selected from the group consisting of animal oils, plant oils, microbial oils, and fats which contain no LCP fatty acids are mixed with a second component selected from the group consisting of animal oils, plant oils, microbial oils, fats, and lecithins which contain arachidonic acid and docosahexaenoic acid in a form selected from the group consisting of phospholipids and triglycerides in a manner known per se, such that the arachidonic acid and docosahexaenoic acids correspond to the values specified in any one of claims 1 to 5.

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